Effect of Different Levels of Organic Manures on Physico-Chemical Properties of Soil UnderCowpea Crop in an Inceptisol of Prayagraj, Uttar Pradesh, India

Abstract

An experiment was conducted on "**Effect of Different Levels of Organic Manures on Physico-Chemical Properties of Soil Under Cowpea Crop in an Inceptisol of Prayagraj, Uttar Pradesh, India**" to observed the combined effect of FYM, Vermi Compost and Neem Cake on soil health and yield. The resultshowed that the application of FYM, Vermi Compost and Neem Cake had a significant and non-significant effect on soil Physico-chemical properties.The maximumbulk density (1.32 Mg $m^{-3}$and 1.35 Mg m^{-3}),particle density(2.46 Mg $m^{-3}$and 2.48 Mg m^{-3}), pH(7.47 and 7.49) and EC (0.251dS m^{-1} and 0.248dS m^{-1})were recorded in T_1(absolute control) at 0-15 cm and 15-30 cm depth. Similarly, the maximum percentage pore space (48.92 % and 45.47 %), water holding capacity (43.96 % and 40.38 %), organic Carbon (0.49 % and 0.47 %), Available Nitrogen (301.14 kg ha^{-1} and 294.97 kg ha^{-1}), Available Phosphorus(30.96 kg ha^{-1} and 27.50 kg ha^{-1}), Available Potassium (196.58 kg $ha^{-1}$and 188.41 kg ha^{-1})wererecorded inT_9(vermicompost @ 2 t $ha^{-1}$and FYM @ 2.5 t ha^{-1}).

Keywords: Soil nutrients, FYM,Vermicompost, Neem cake and Cowpea.

1. Introduction

Cowpea is one of the important legume vegetable crops grown in India. It 1s also known as black eye pea,southern pea and Crowder pea, well adapted to many areas of the humid tropics and sub-tropical zones. It isgrown throughout India for its long, green vegetable pods, seeds and foliage for fodder. There is world-wideconsensus that sole dependence on chemical input-based agriculture is not suitable in long run and onlyintegratedplantnutrientsystem(IPNS)involvingacombinationoffertilizer,organicmanuresandbio-fertilizersare essential to sustain crop production, preserve soil heat and biodiversity. In addition to this, the organicmanureshelp inimprovingthe useefficiency ofinorganicfertilizersSinghandBiswas[13].

Crop residues are a potential source of organic matter in soils. Essentially, the presence of organicmatter in soils is responsible for improved chemical and Integrated use of vermi compost and bio fertilizers increases the nutrient status of soil at harvest stage. Available P and micronutrient level

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increases with combine use of bio fertilizers and vermi compost. Organic compost is a very important method of providing the plants with their nutritional requirements without having an undesirable impact on the environment Adeoye*et al.*, [1].

Organic manures viz., FYM, vermicompost, poultry manure and oilcakes help in the improvement ofsoilstructure,aerationandwater holdingcapacityof soil.Further,itstimulatesthe activity ofmicroorganismsthatmakestheplanttogetthemacroandmicro-nutrientsthroughenhancedbiologicalprocesses,increasenutrient solubility,altersoilsalinity,sodicity andpHAlabadan*etal.*,[2].

Incorporation of FYM or organicmanure alone or integration with chemicalfertilizers improves not only the nutrient useefficiency, but also increases availablenutrient status of soil with enhanced soilbiological activity which in turn provides acongenial physical condition and improvedavailability of nutrient in the rhizosphereKanwar*et al.*, [7].

Neem Cakes are more cost efficient because the fertilizer in them lasts longer. The Neem Cake remains effective until the next crop is planted because of its long sustaining organic fertilizer compounds too. This, in turn, cuts the cost of having to add extra nutrients; always a bonus. This soil amendment is twofold. It will provide a better crop yield because it will provide the nutrients that crops need. And secondly, it helps to cure diseases and will control the growth of nematodes and harmful plant pathogens. Plus, the crop yield is15-25% higher when using. Neem Cakes than with any other fertilizer. Neem Cakes can also improve the organic content of the soil by providing lots of micro and macro nutrients. This also improves the fertility of the soil in which your plants or crops are planted. The use of Neem Cakes too will increase the water holding capability of the soil and improve soil structure. With the soil improvement there will be an increase in beneficial organisms like earthworms also Additionally, Neem Cake will help improve to the texture of your soil, the organic content and water holding capacity as stated as well as helping to keep the soil aerated for root development Kaur*et al.*, [5].

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2. Materials and Methods:

2.1 Experimental Site and Location

The experiment was conducted at the Research Farm of Soil Science at Sam Higginbottom University of Agriculture, Technology Sciences, Prayagraj which is located at $25^0$24'30" N latitude, 81^0 51'10" E longitude and 98 m above the mean sea level and is situated 6 km away on the right bank of Yamuna river. Representing the Agro-Ecological Sub Region [North Alluvium plain zone (0-1% slope)] and Agro-Climatic Zone (Upper Gangetic Plain Region).

Table 1.Details of treatmentcombination

S.No.	Treatment combination	Symbol
T_1	Absolute Control,	
T_2	Vermicompost @ 50% and Neem cake @ 50%	V_1N_1
T_3	Vermicompost @ 50%and Neem cake @ 100%	V_1N_2
T_4	Vermicompost @50%and FYM @ 50%	V_1F_1
T_5	Vermicompost @50% and FYM @ 100%	V_1F_2
T_6	Vermicompost @ 100% and Neem cake @ 50%	V_2N_1
T_7	Vermicompost @ 100%and Neem cake @ 100%	V_2N_2
T_8	Vermicompost @ 100%and FYM @ 50%	V_2F_1
T_9	Vermicompost @ 100%and FYM @ 100%	V_2F_2

Note: Recommended dose of fertilizer was applied at the time of sowing **(**P = @ 20 Kg ha^{-1}, K= @ 20 Kg ha^{-1}) (N was applied in two different doses @ 40 kg ha^{-1}), FYM@ 5 t ha^{-1},Vermicompost @ 2 t ha^{-1} and Neem cake @ 2.64 t ha^{-1}.

2.2 Climate Condition

The area of Prayagraj district comes under subtropical belt in the South east of Uttar Pradesh, which experience extremely hot summer and cold winter. The maximum temperature of the location reaches up to 46^0C – 48^0C and seldom falls as low as 4^0C – 5^0C. The relative humidity ranged between 20 to 94 percent. The average rainfall in this area is around 1100 mm annually. Prayagraj has a sub- tropical and semi- arid climate with rain mostly during July- September.

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2.3 Experimental Design

The experiment was conducted in randomized block design (RBD) having nine treatment combination which is replicated thrice, randomly allocated in each replication, dividing into 27 plots.

Comment [DS228]: a randomized complete block design (RCBD)

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In the study, Organic manures like FYM, Vermicompost and Neem Cake was applied in two different doses. Sowing of the cow pea crop was carried out on the 15th of March, 2022 respectively, by hand. The seed variety kashiNidhi was sown at a rate of 25 kgha^{-1} and at a row to row spacing of 30 cm and plant to plant spacing of 15 cm.

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2.4Soil Analysis

The soils from each plot were separatelycollected, air-dried, ground, and passed througha 2-mm-size sieve for laboratory analysis. Soilsamples were analyzed for bulk density, particledensity, Percentage pore space, and waterholding capacity (Muthuvel*et al*., 1992) [9], pH(Jackson, 1967) [4], EC (Wilcox, 1950) [17], Percentage OrganicCarbon (Walkley and Black, 1934) [16], AvailableNitrogen (Subbiah and Asiija, 1956) [14],Available Phosphorus (Olsen *et al*., 1954) [10]and Available Potassium (Toth and Prince, 1949)[15] before sowing and after harvest of the crop.

2.5Statistical analysis

The statistical analysis of the data was carriedout using STATISTICA (7.0) software.

3. Results and Discussion

3.1 Effect of different levels of organic manures on physical properties of soil after harvest of cowpea

The result observed intreatment T_1 non- significantly higher bulk density (1.32 Mg m^{-3} and 1.35 Mg m^{-3}),particle density (2.46 Mg m^{-3}and 2.48 Mg m^{-3}) and significantlyhigher percentage pore space (48.92 % and 45.47 %) and Water holding capacity (43.96 % and 40.38 %) were recorded in T_9 (absolute control) at 0-15 cm and 15-30 cm depth.This corroborates with the findings of Pradeepa*et al*., [12], Kumar *etal*., [8] and Babaji*et al*.,[3].

3.2 Effectofdifferent levels of organicmanureson soilon chemical properties of soil after harvest of cowpea

The result observed in treatment T_1non significantly higher soil pH(7.47 and 7.49) and significantly higher Electrical conductivity (0.251dS m^{-1} and 0.248dS m^{-1}) at 0-15 cm and 15-30 cm. There was significantly higher percentage Organic Carbon (0.49 % and 0.47 %), Available Nitrogen (301.14 kg ha^{-1}and 294.97 kg ha^{-1}), Available Phosphorus(30.96 kg ha^{-1} and 27.50 kg ha^{-1}), Available Potassium (196.58 kg ha^{-1}and 188.41 kg ha^{-1})wererecorded inT_9 at 0-15cm and 15-30 cm

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depth.This corroborates with the findings of Khandelwal*et al.*,[6], Adeoye*et al.*,[1] and Pandey*et al.*,[11].

Table No.2: Effect of different levels of organic manures on bulk density, particle density, pore space, water holding capacity and pH

S. No.	Treatment combination	Bulk Density ($Mg\ m^{-3}$)		Particle Density ($Mg\ m^{-3}$)		Pore space (%)		Water holding Capacity (%)		pH	
		0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm
T_1	Absolute Control	1.32	1.35	2.46	2.48	42.22	39.12	38.21	33.37	7.47	7.49
T_2	Vermicompost 50 % and Neem cake 50 %	1.29	1.32	2.44	2.47	43.38	41.25	39.32	33.67	7.45	7.48
T_3	Vermicompost 50% and Neem cake 100%	1.25	1.27	2.41	2.43	44.53	41.34	40.38	37.94	7.36	7.39
T_4	Vermicompost 50% and FYM 50 %	1.27	1.30	2.43	2.45	43.98	40.31	39.98	35.44	7.43	7.46
T_5	Vermicompost 50 % and FYM 100 %	1.22	1.24	2.38	2.39	46.32	43.16	41.37	38.31	7.31	7.33
T_6	Vermicompost 100 % and Neem cake 50 %	1.24	1.26	2.40	2.42	45.84	41.37	40.91	36.26	7.34	7.38
T_7	Vermicompost 100 % and Neem cake 100 %	1.19	1.20	2.30	2.35	48.36	43.33	43.28	39.87	7.23	7.24
T_8	Vermicompost 100 % and FYM 50 %	1.20	1.23	2.36	2.39	47.64	43.28	42.84	36.35	7.27	7.26
T_9	Vermicompost 100 % and FYM 100%	1.17	1.19	2.27	2.29	48.92	45.47	43.96	40.38	7.20	7.22
F(test)		NS	NS	NS	NS	S	S	S	S	NS	NS
S.Em. ±						0.82	0.44	0.66	0.62		
C.D. at 5%						2.48	1.32	1.99	1.88		

Table No.3:Effectofdifferent levels of organicmanureon Electrical Conductivity, Organic Carbon, Available Nitrogen, Available Phosphorus and Available Potassium

S. No.	Treatment combination	EC (dS m^{-1})		Organic Carbon (%)		Available Nitrogen (kg ha^{-1})		Available Phosphorus (kg ha^{-1})		Available Potassium (kg ha^{-1})	
		0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm
T_1	Absolute Control	0.251	0.248	0.35	0.31	245.88	236.80	16.38	14.35	138.25	130.32
T_2	Vermicompost 50 % and Neem cake 50 %	0.248	0.244	0.38	0.35	253.73	248.34	17.47	15.64	140.59	132.77
T_3	Vermicompost 50% and Neem cake 100%	0.242	0.239	0.42	0.41	273.80	265.66	22.34	20.79	148.88	137.87
T_4	Vermicompost 50% and FYM 50 %	0.244	0.242	0.40	0.38	265.52	257.91	20.37	17.92	146.59	139.05
T_5	Vermicompost 50 % and FYM 100 %	0.231	0.227	0.44	0.42	285.45	276.94	23.47	22.55	166.72	156.11
T_6	Vermicompost 100 % and Neem cake 50 %	0.237	0.232	0.42	0.40	278.99	270.40	23.52	21.43	158.33	138.62
T_7	Vermicompost 100 % and Neem cake 100 %	0.220	0.218	0.47	0.45	298.95	283.48	28.12	24.68	187.17	171.95
T_8	Vermicompost 100 % and FYM 50 %	0.229	0.225	0.46	0.43	294.28	286.50	25.08	23.75	176.32	162.02
T_9	Vermicompost 100 % and FYM 100%	0.216	0.213	0.49	0.47	301.14	294.97	30.96	27.50	196.58	188.41
F(test)		S	S	S	S	S	S	S	S	S	S
S.Em. ±		0.004	0.004	0.006	0.006	3.17	3.80	0.33	0.33	2.79	2.03
C.D. at 5%		0.011	0.011	0.019	0.02	9.54	11.45	1.01	0.99	8.42	6.13

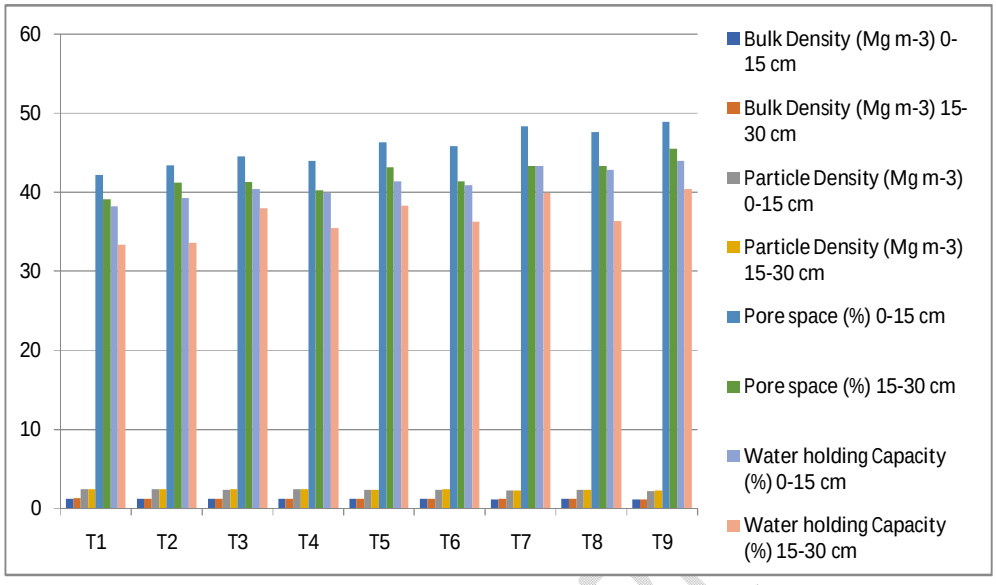

Fig No.1:Effect of different levels of organic manures on bulk density, particle density, pore space and water holding capacity

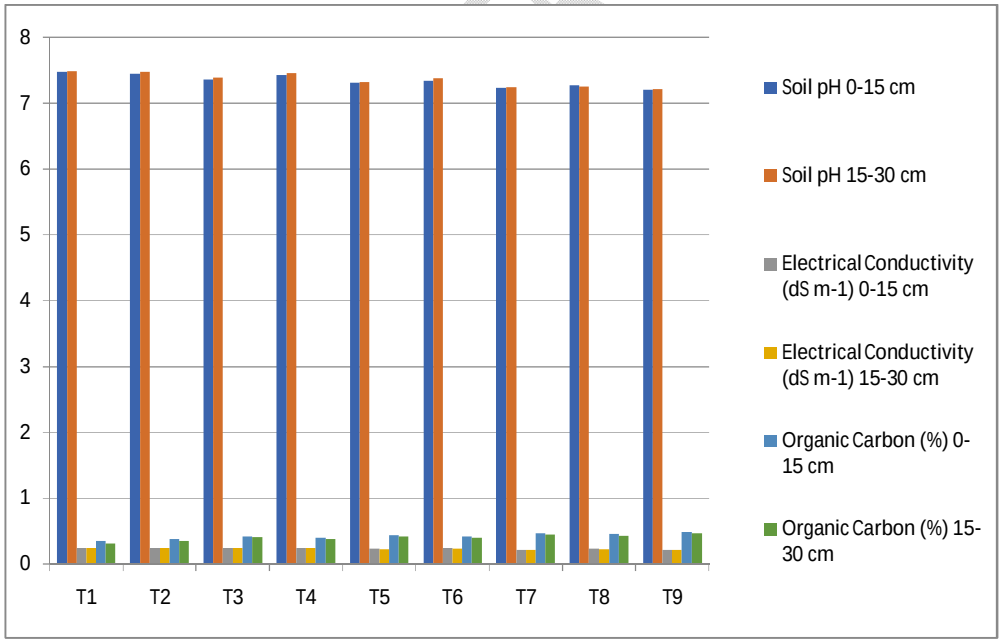

Fig No.2:Effect of different levels of organic manures on soil pH and Electrical Conductivity and Organic Carbon

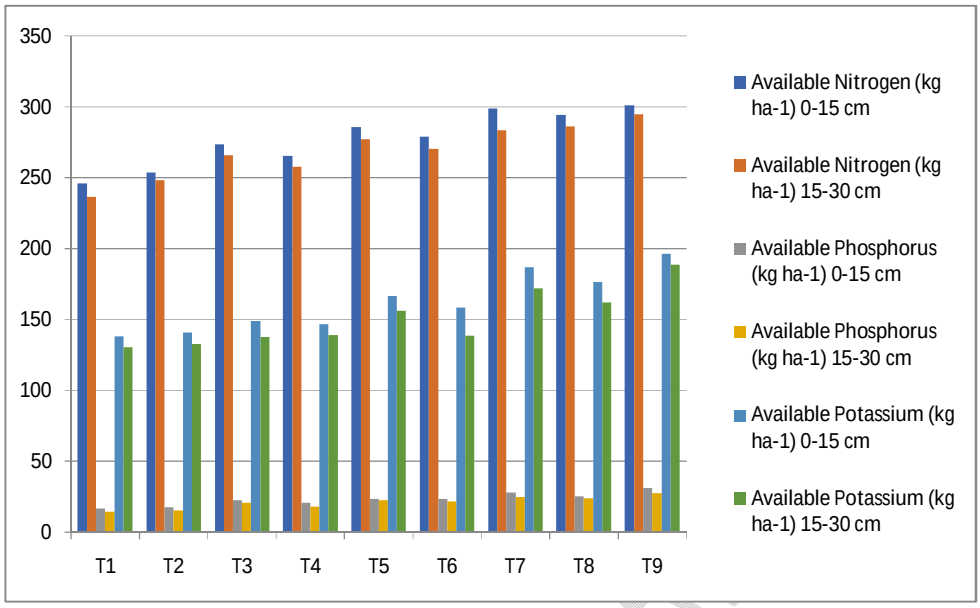

Fig No.3:Effect of different levels of organic manures on Available Nitrogen, Available Phosphorus and Available Potassium

Conclusion

Conclusion based on the results; the application of organic manures was found to improve the soil health in reference to cowpea. Application of T_9 (Vermicompost @ 2 t ha^{-1} and FYM @ 5 t ha^{-1}] was found optimal for improving soil properties like pore space, water holding capacity,Available Nitrogen, Available phosphorus and Available potassium.

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